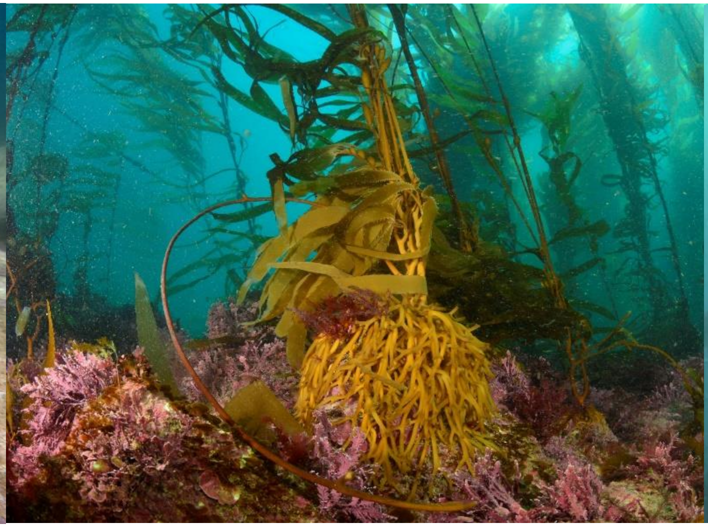
National Science Challenges

SUSTAINABLE SEAS

Ko ngā moana whakauka

Degradation, tipping points and recovery of NZ’s rocky reef ecosystems



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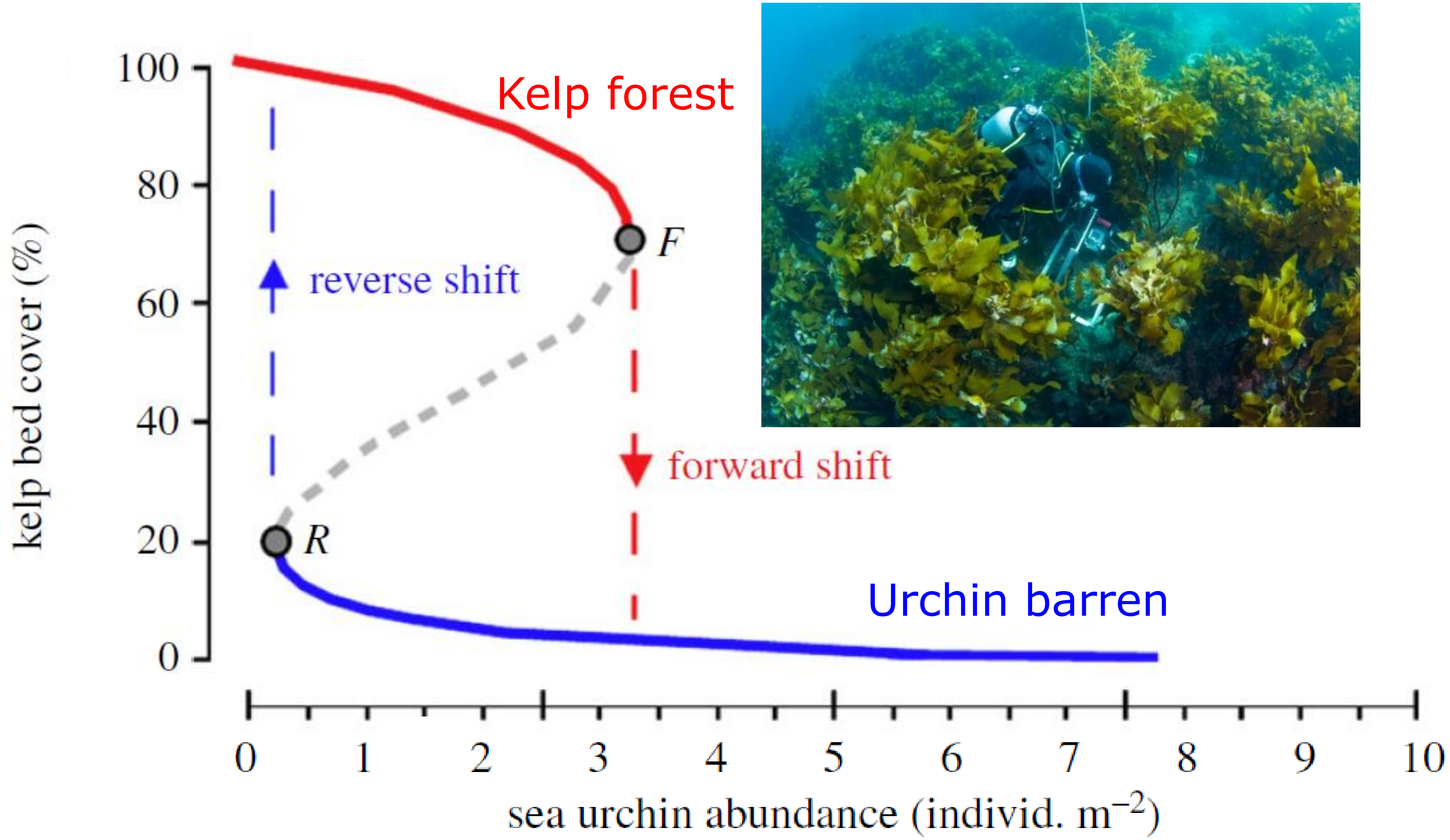
Tipping points and regime shifts

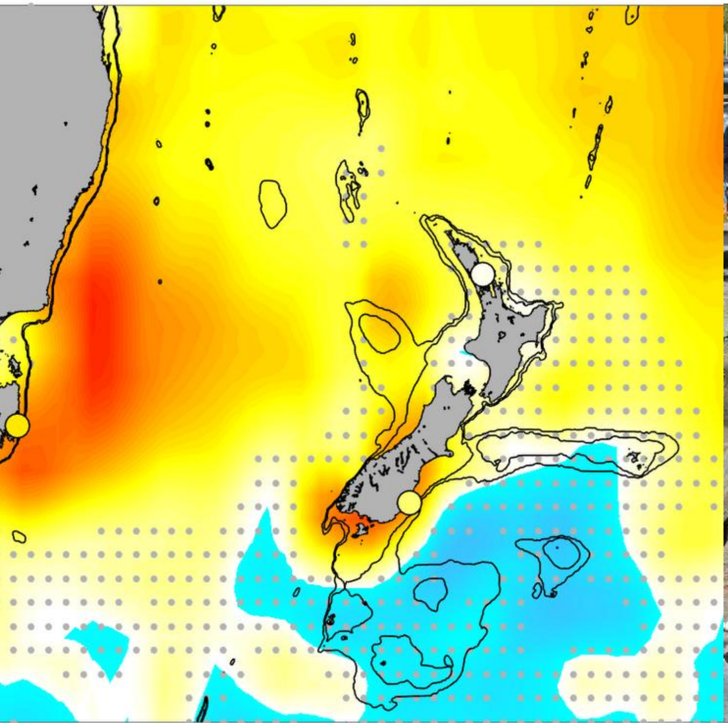
Non-linear changes in ecosystem structure and function that are often costly and hard to reverse

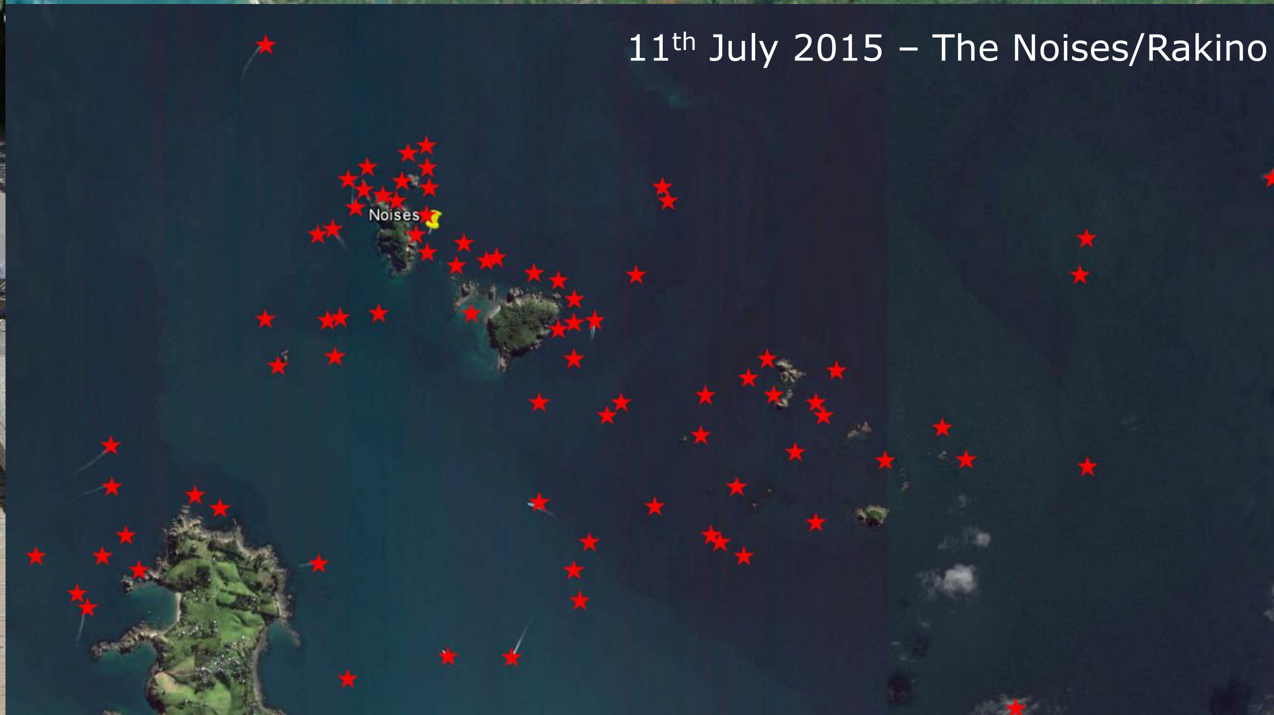


Ling et al (2015) Global regime shift dynamics of catastrophic sea urchin overgrazing. *Phil B.*

Stressors on rocky reef ecosystems

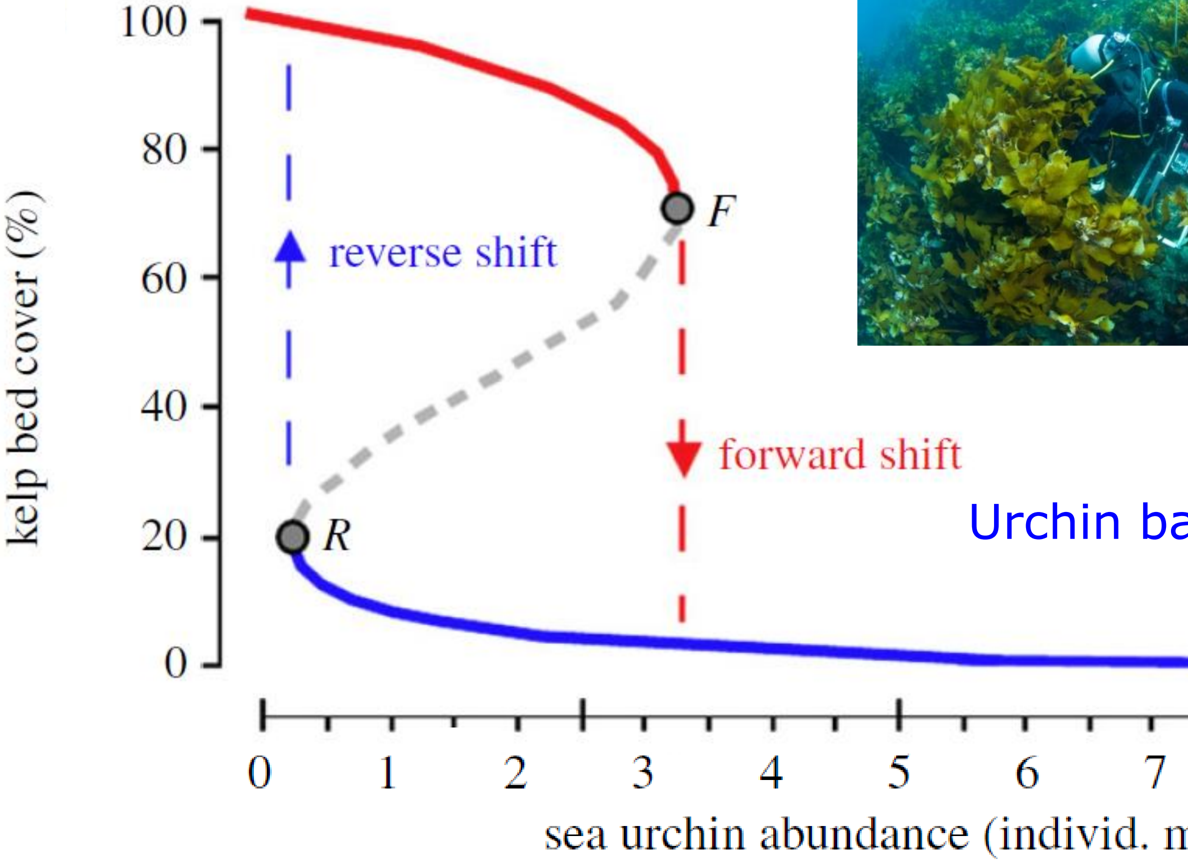
- Fishing
- Sedimentation
- Climate change





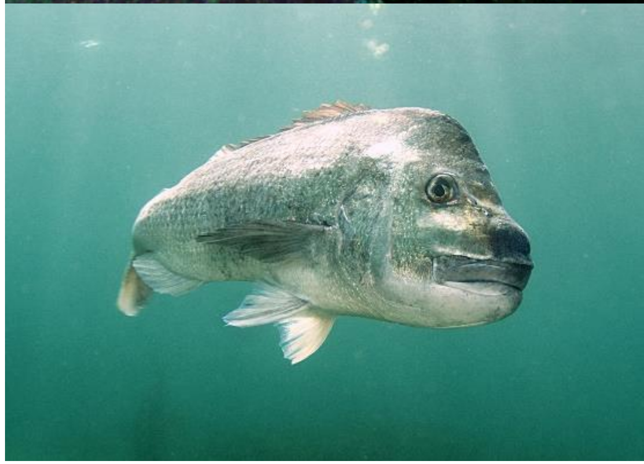
Fishing impacts on reefs

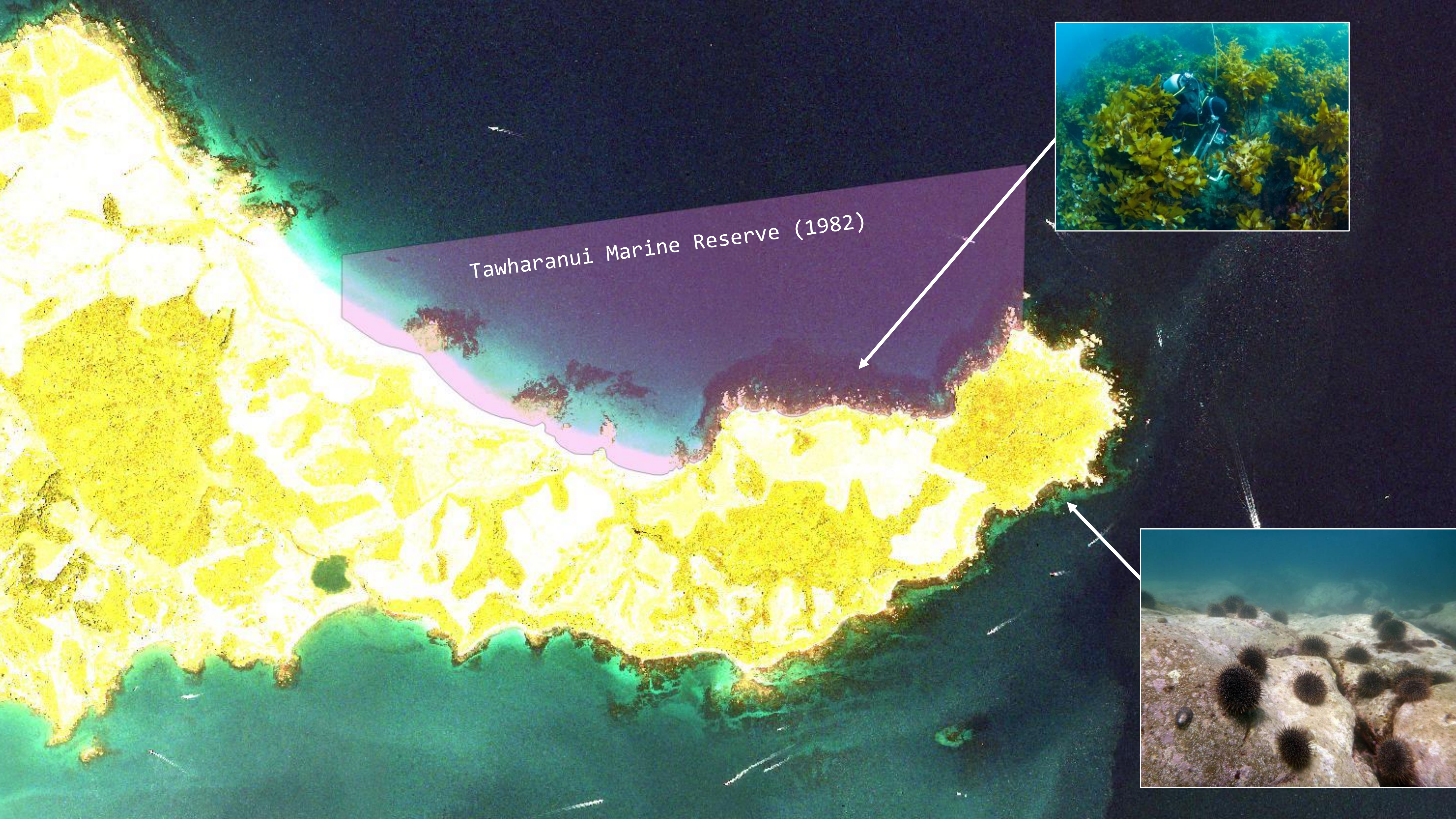
- Marine reserves provide experimental evidence that shifts from kelp to barrens in NZ are due to fishing of sea urchin predators



Kelp forest

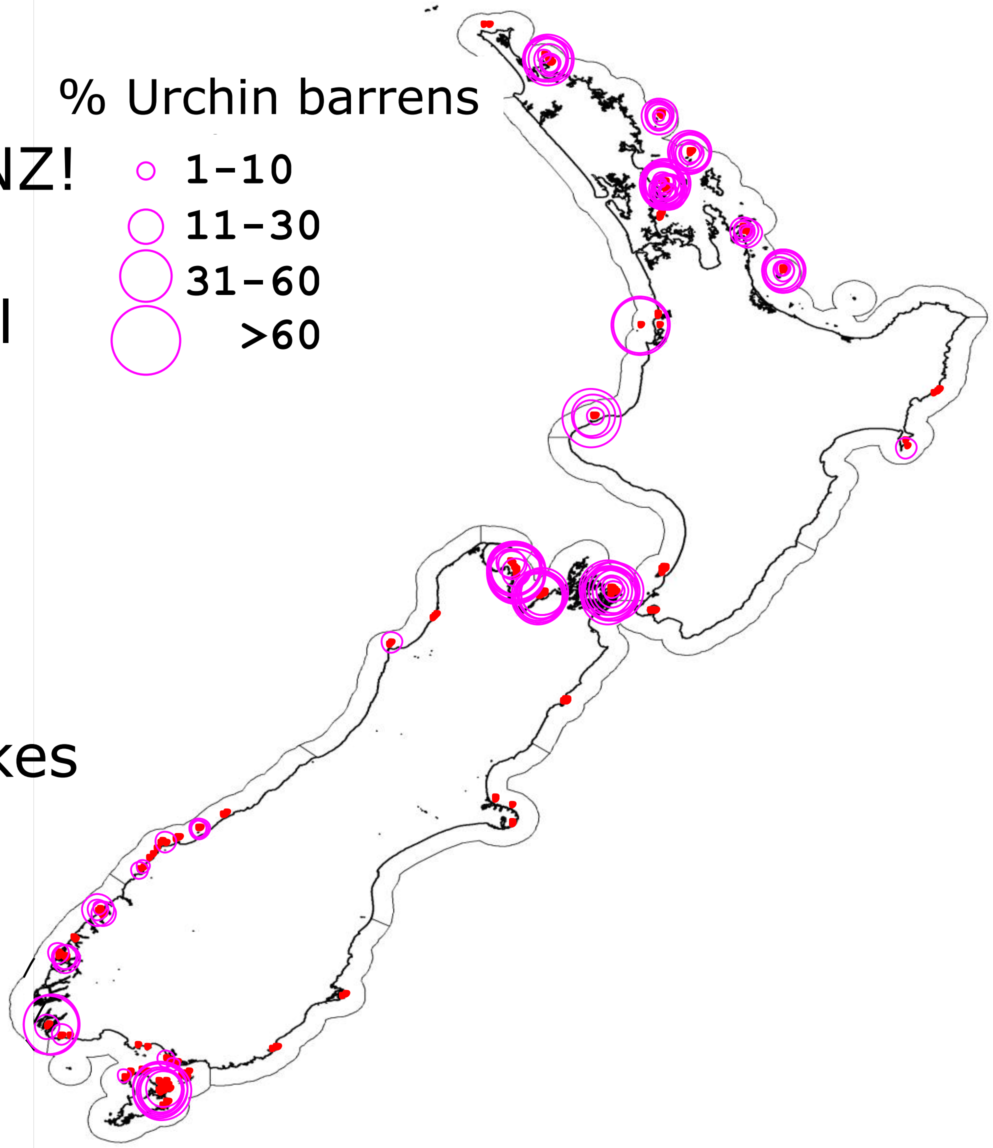
Urchin barren



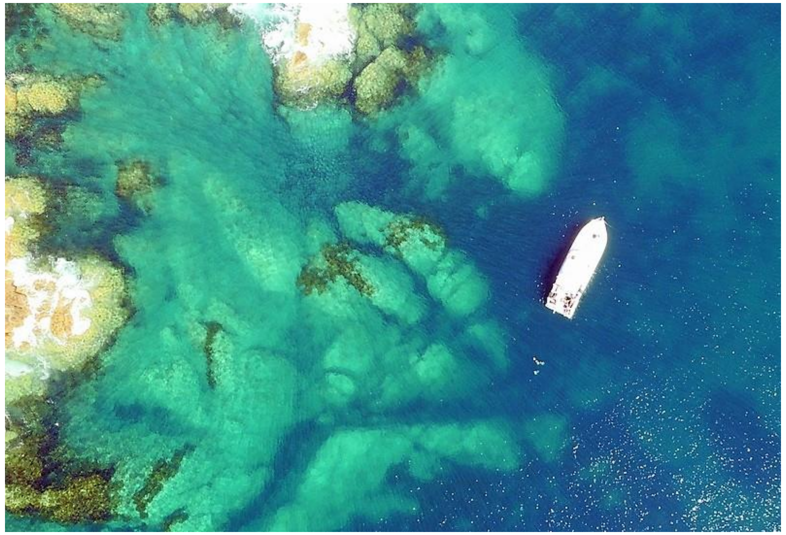

Tawharanui Marine Reserve (1982)

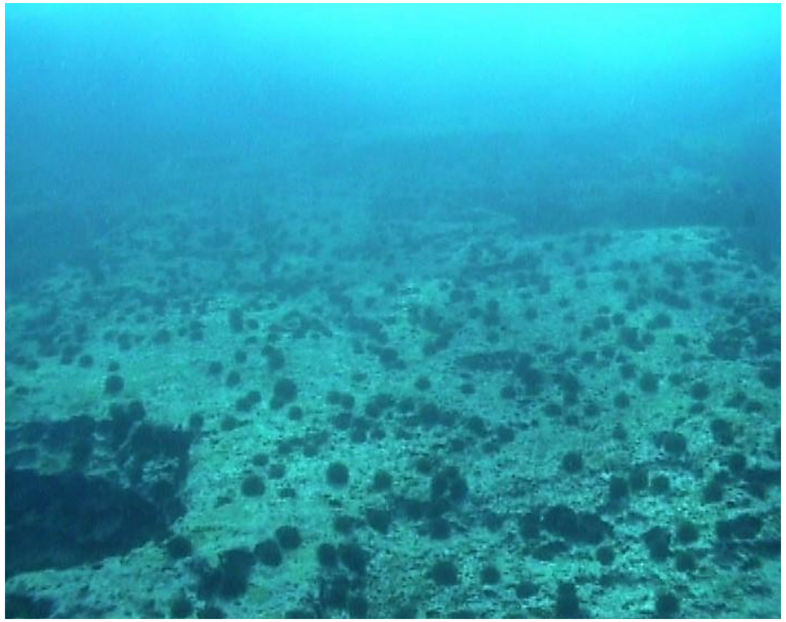
Extent of urchin barrens on NZ reefs

- Not just in northern NZ!
- Only occur under certain environmental conditions
- Valuable indicator for EBM in some regions
- Recovery is possible through spatial management (but takes time)
- Other stressors may exacerbate or alter dynamics



(Shears and Babcock 2007, unpub. data)





Sedimentation

Highly erosive soils

↓

Poor land management

↓

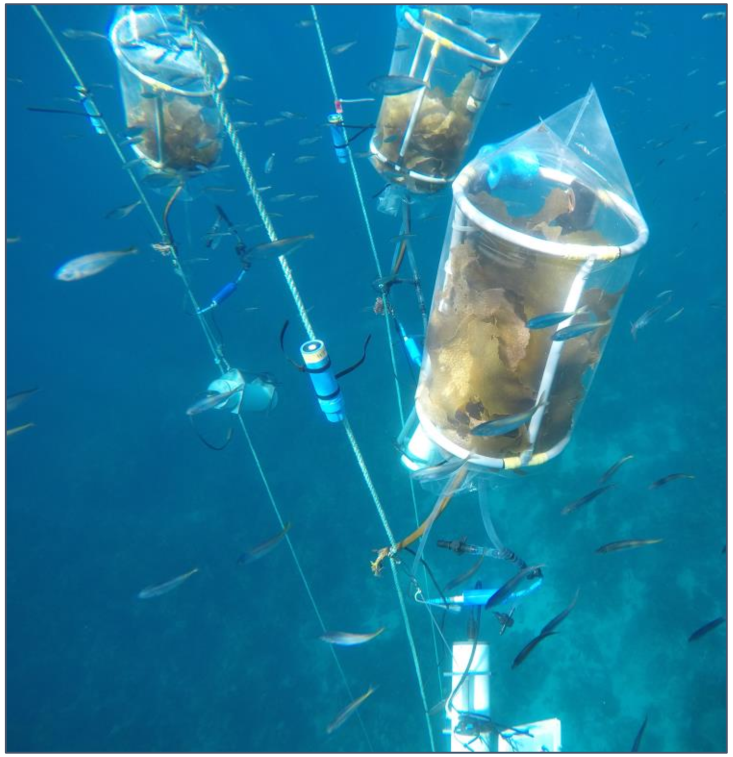
High sediment loads in many regions

↓

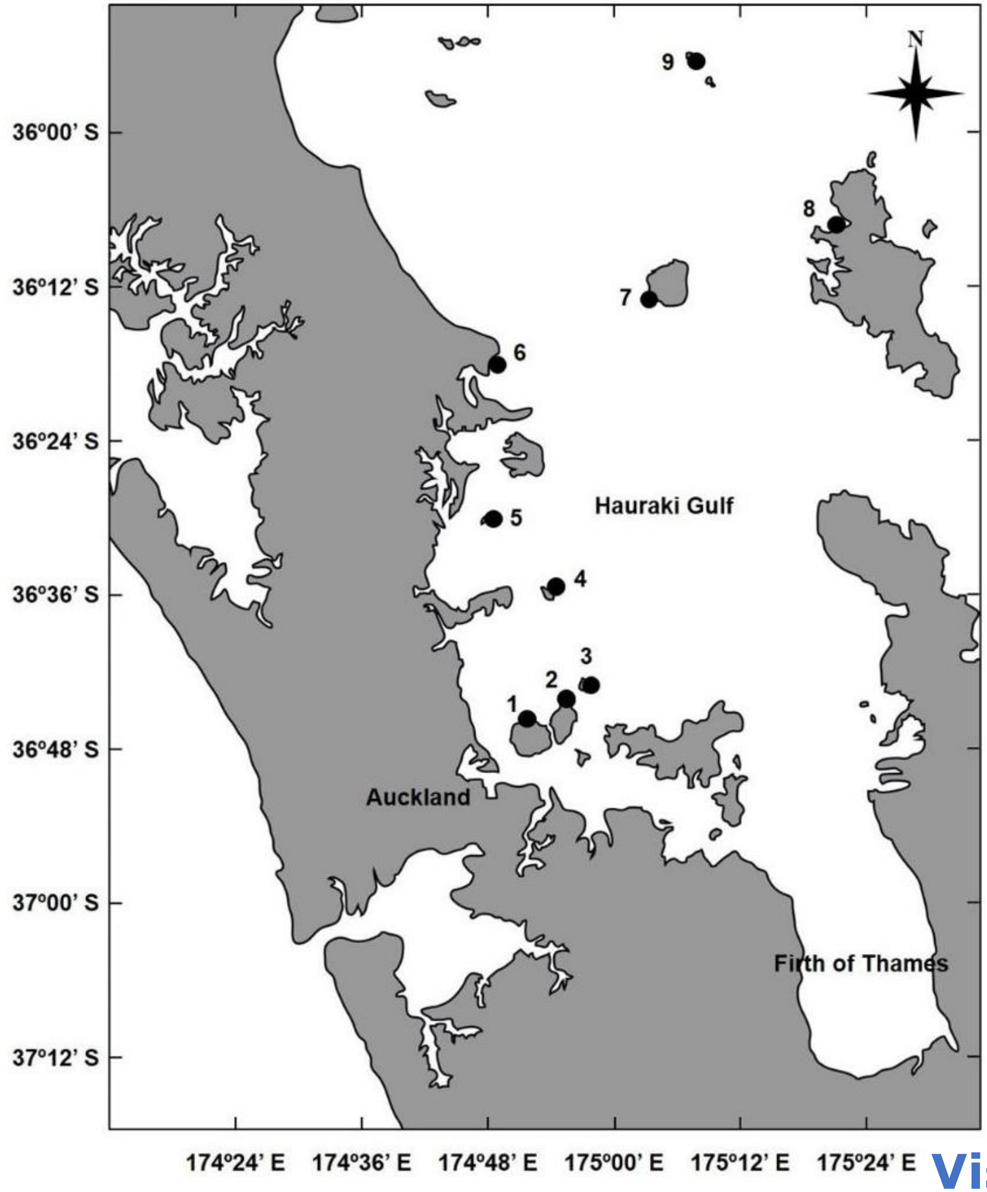
Reduced light and high sediment deposition

Sedimentation and tipping points on rocky reefs

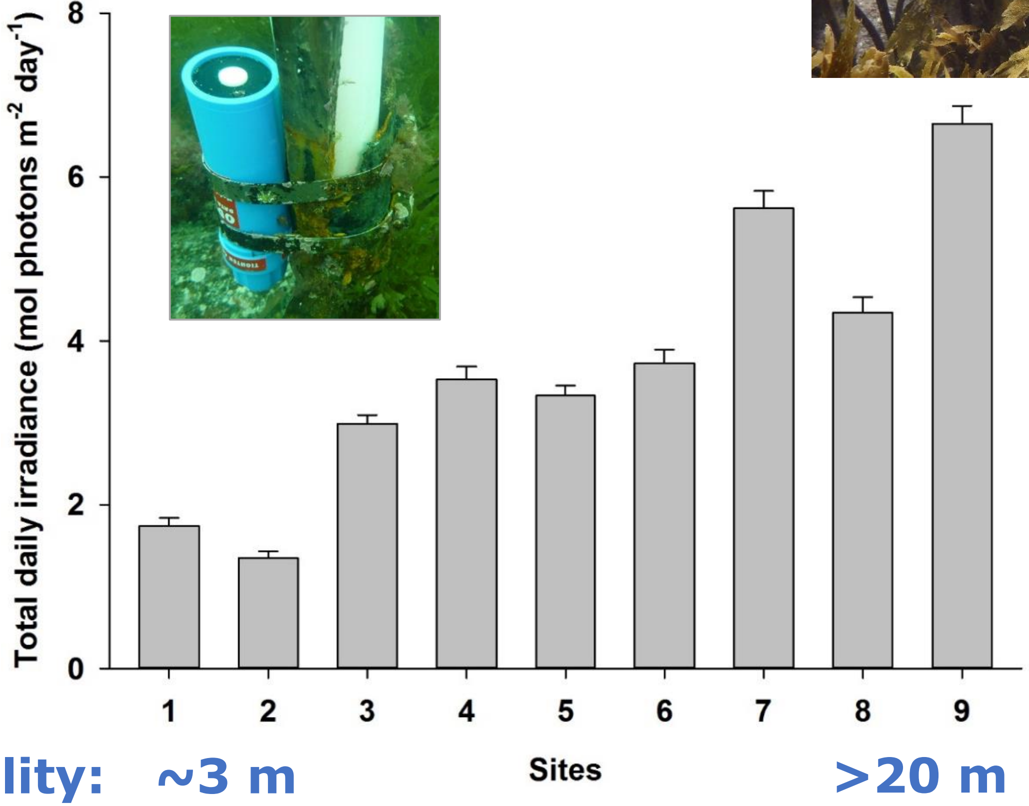
- Examine seaweed distributions across gradients in turbidity (Hauraki Gulf, Banks Peninsula and Marlborough Sounds)
- Field and lab-based photosynthetic measurements of different species
- Estimates of primary productivity
- Mesocosm experiments examining acclimation and tolerance to low light
- Field experiment examining resilience

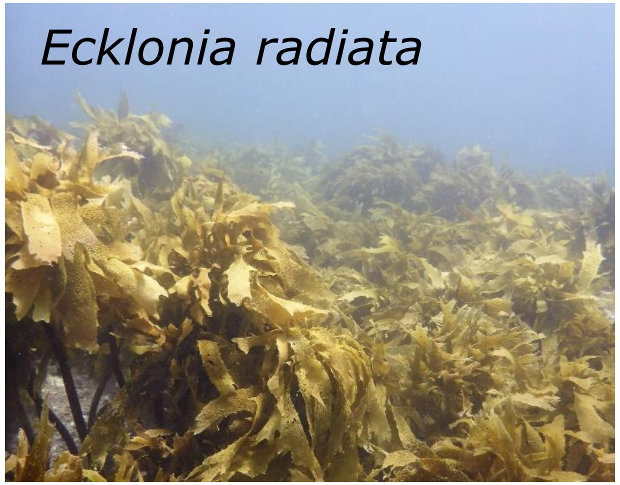


Kelp forests in the Hauraki Gulf



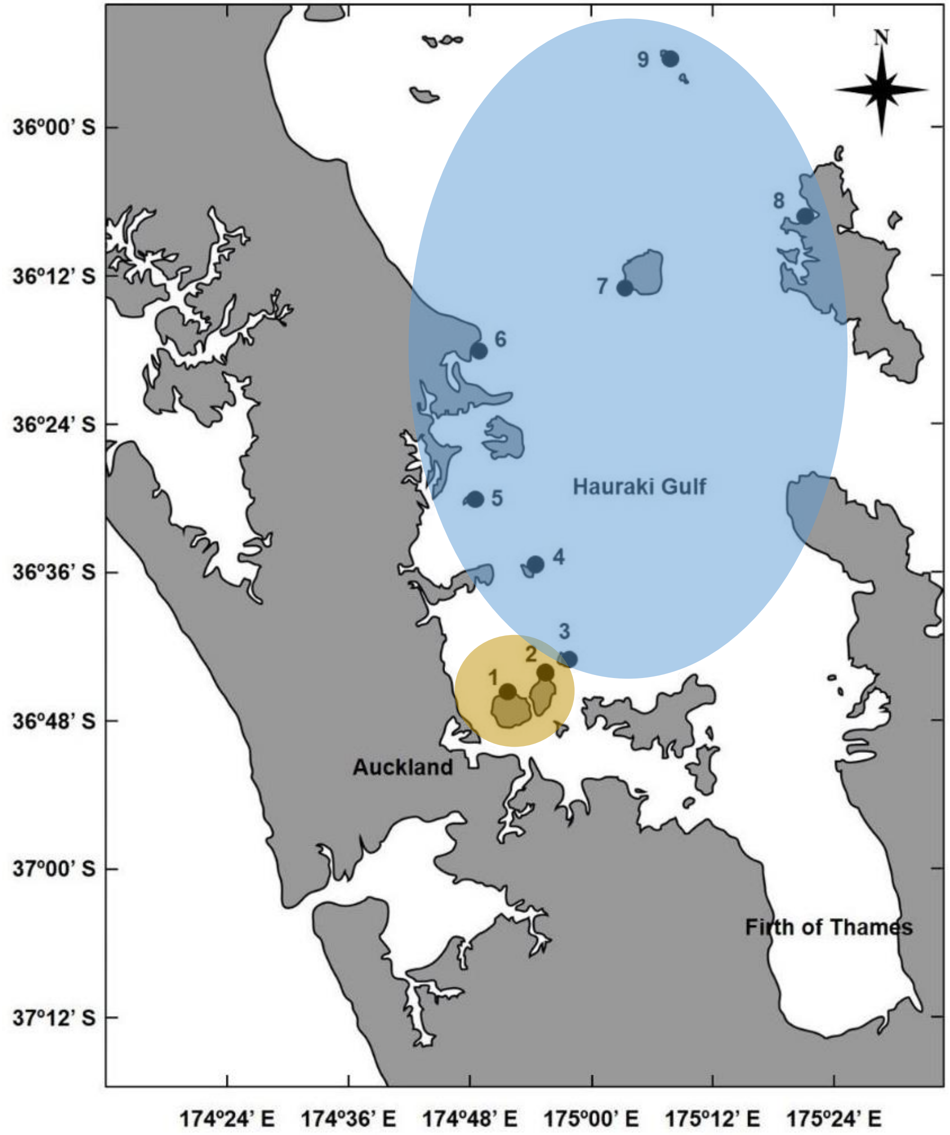
Light @10m depth





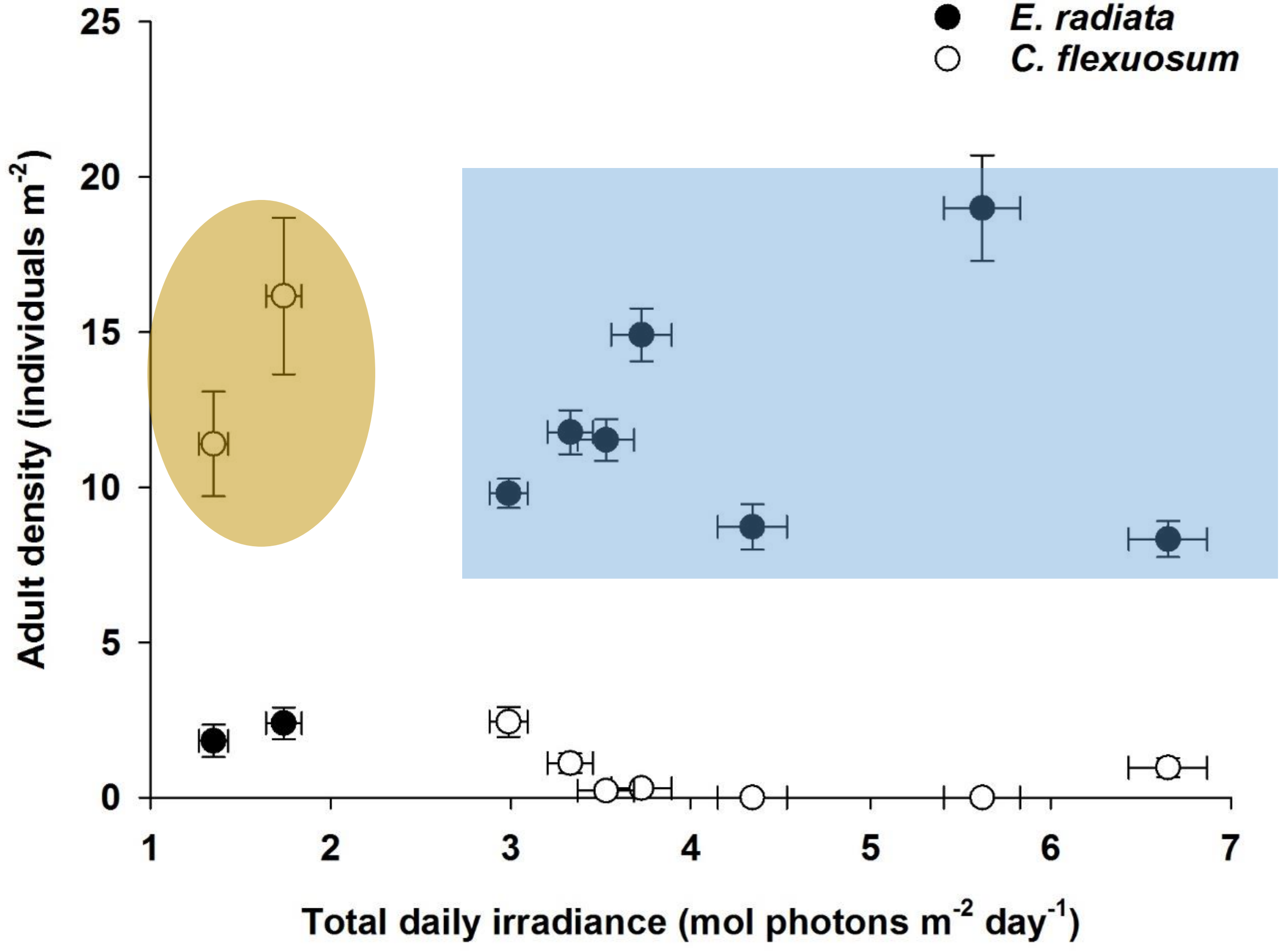
Visibility: ~3 m **>20 m**

Shifts in macroalgal assemblages (@ 10 m depth)



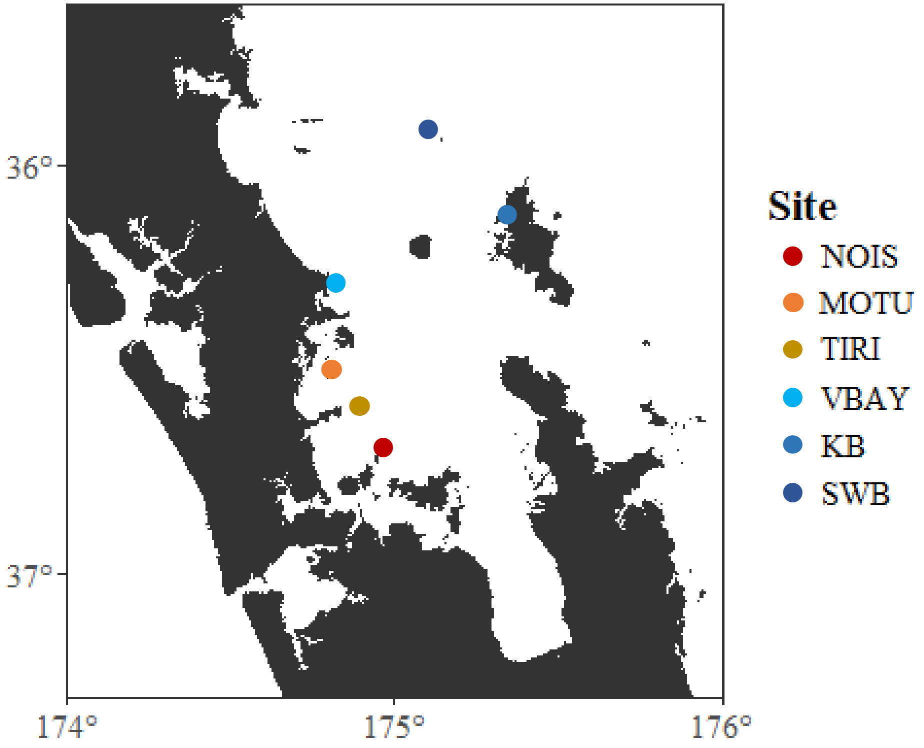
High turbidity
C. flexuosum forests

Low turbidity/Clear water
Ecklonia radiata forest

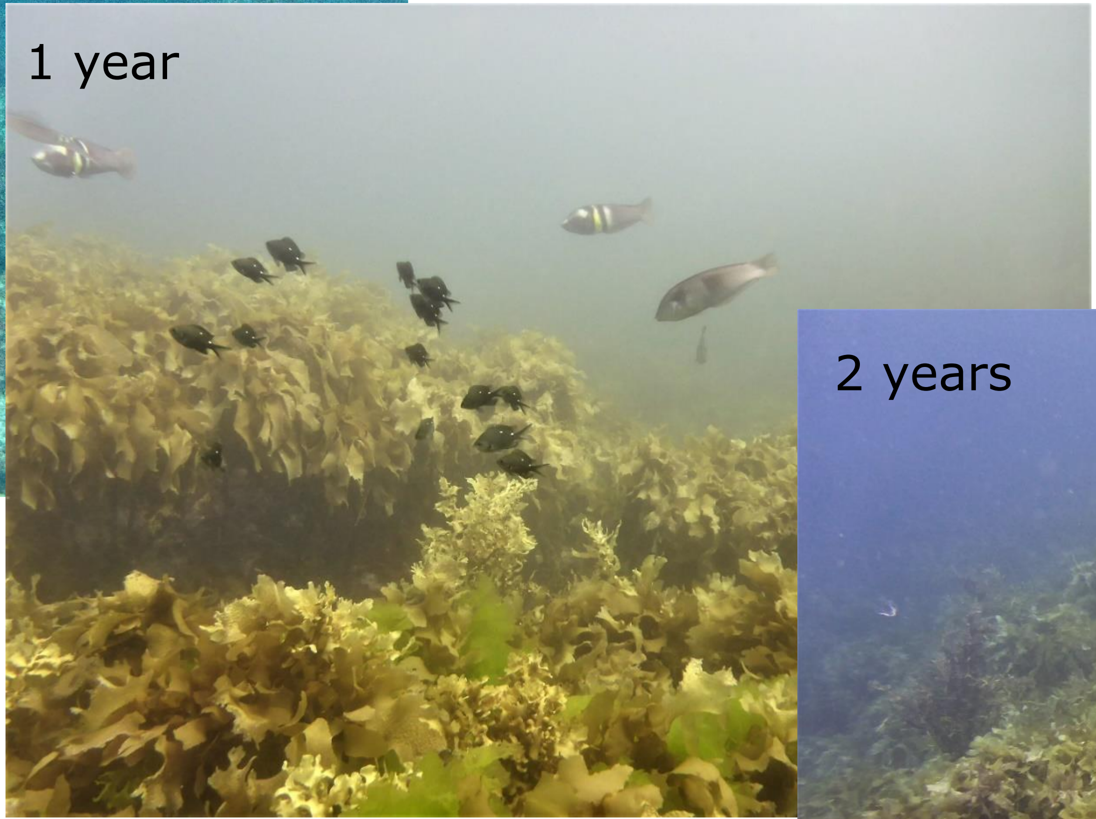


Reduced resilience of kelp at turbid sites

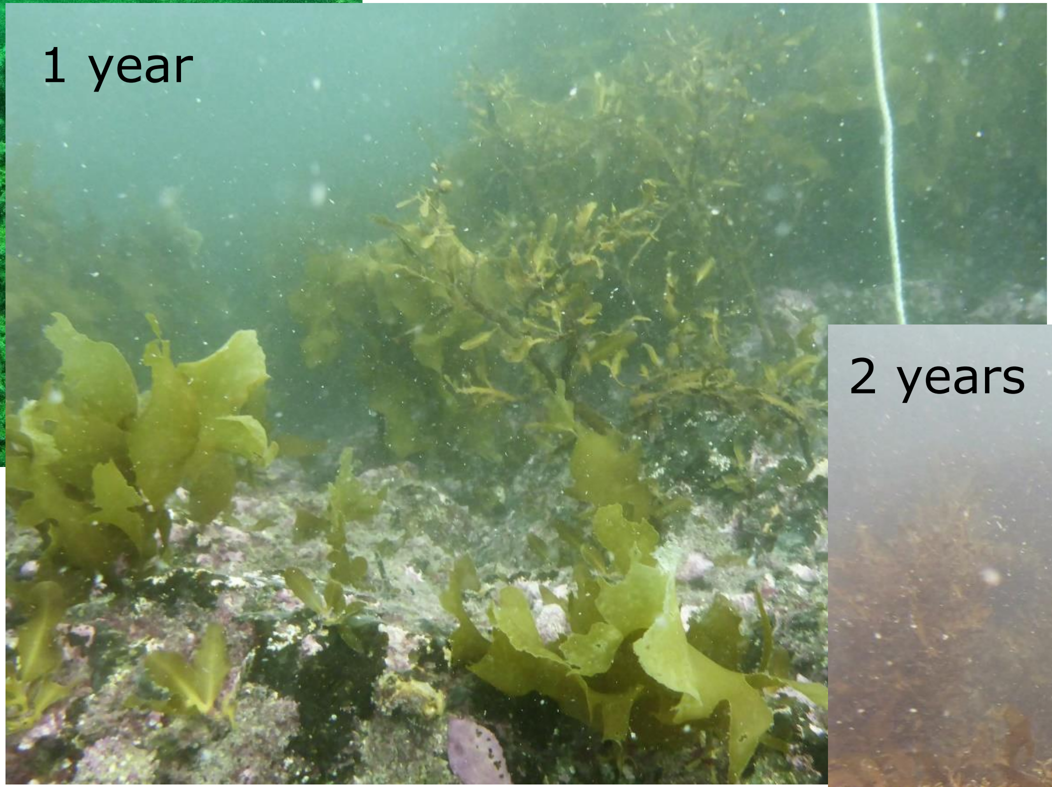
- Experimental removal of kelp
- Slower recovery at turbid sites
- Shift to *C. flexuosum*

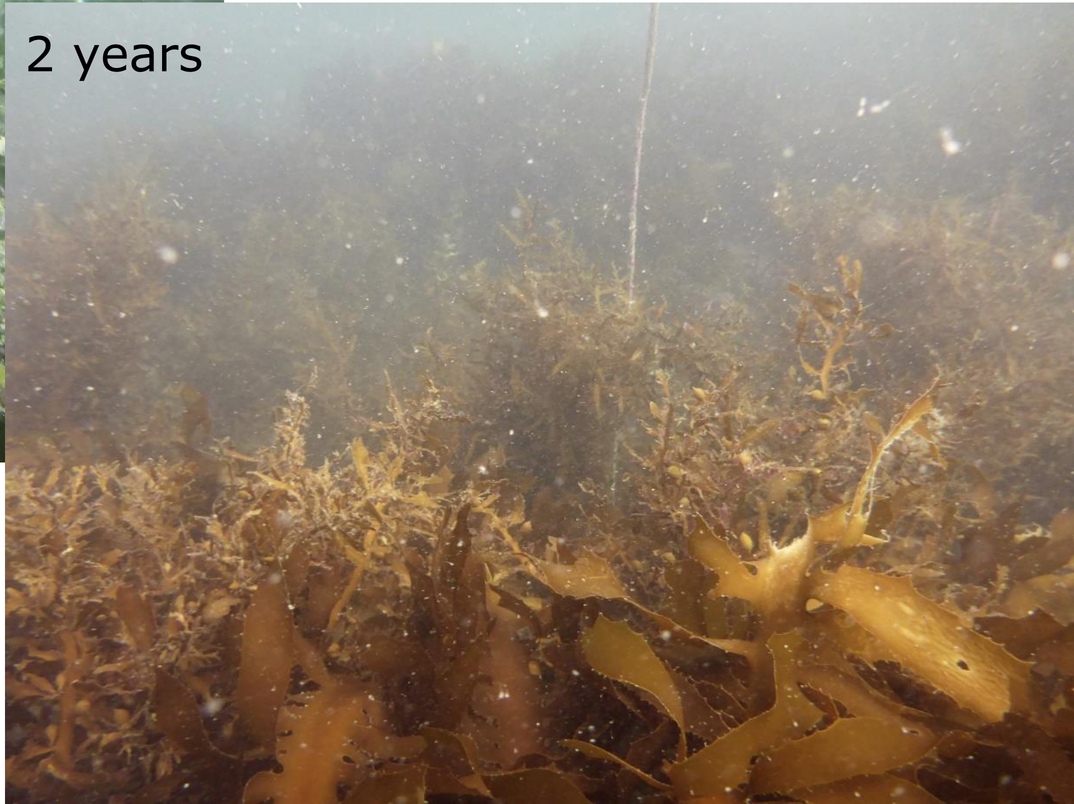


SWB, Mokohinau Islands – Clearest site



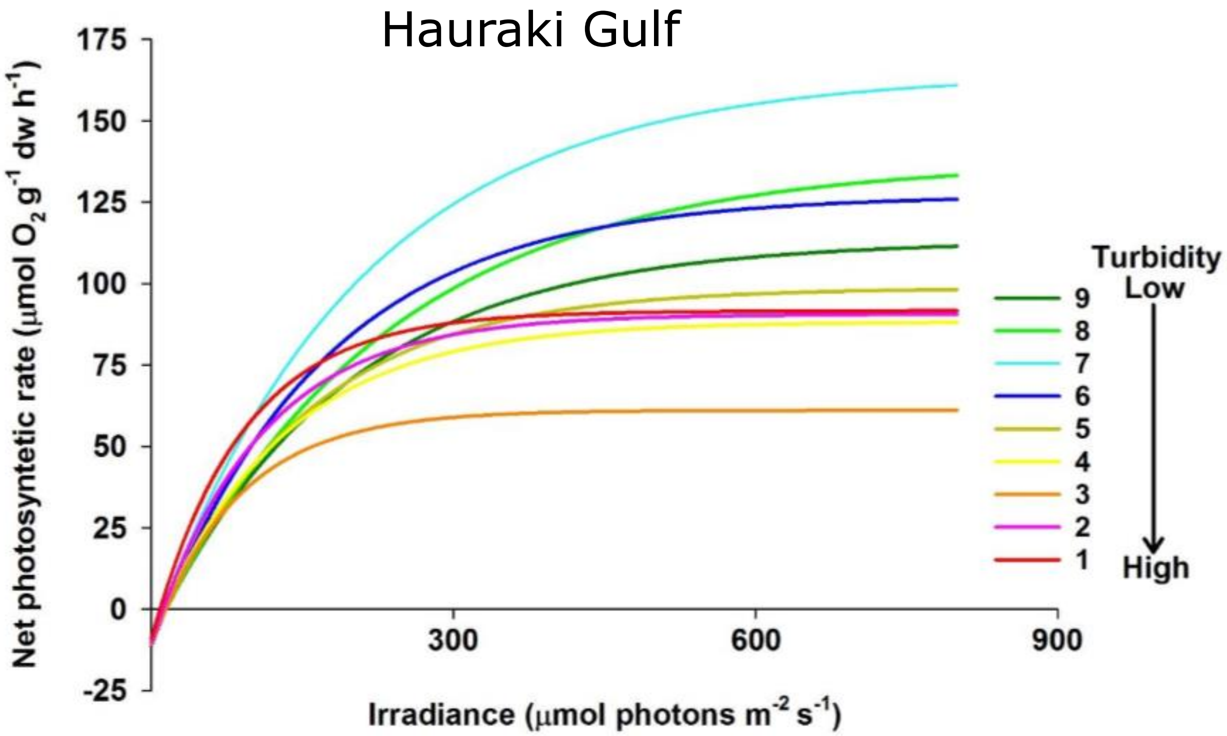
Noises Islands – Most turbid site

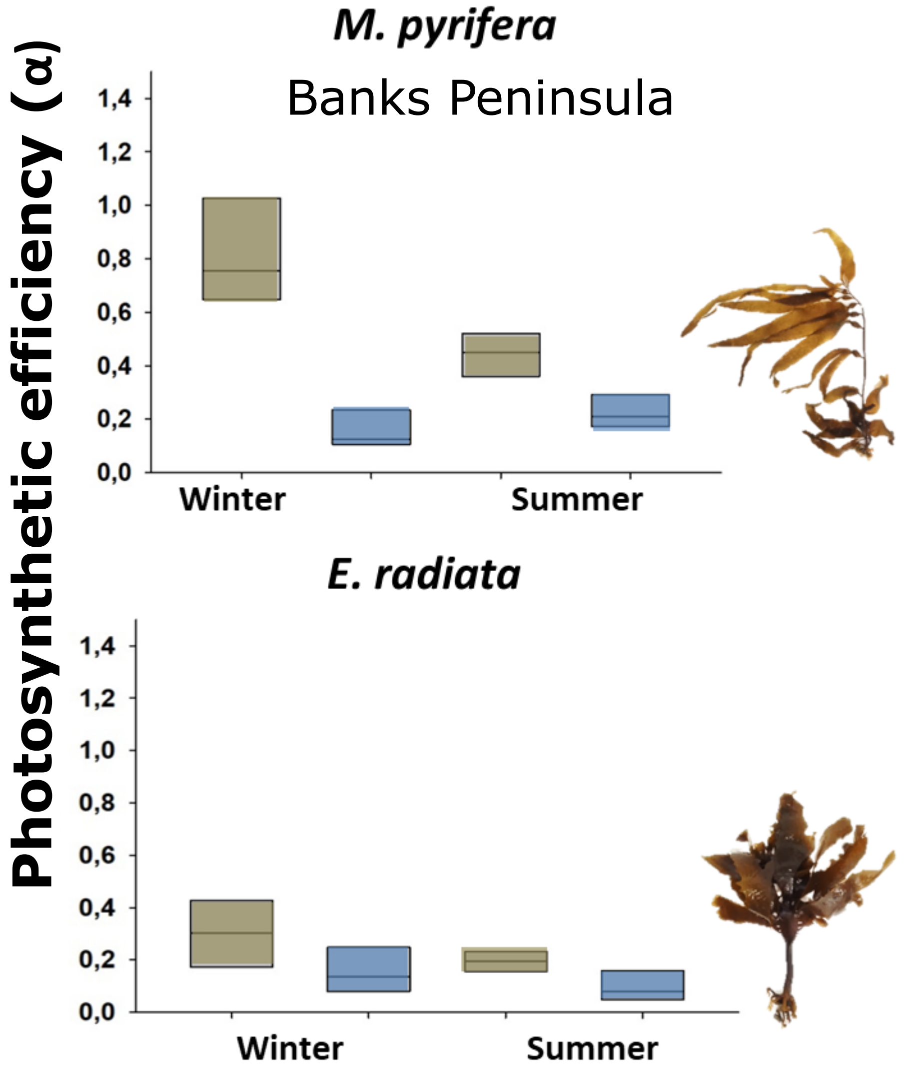




Adaptation to low light

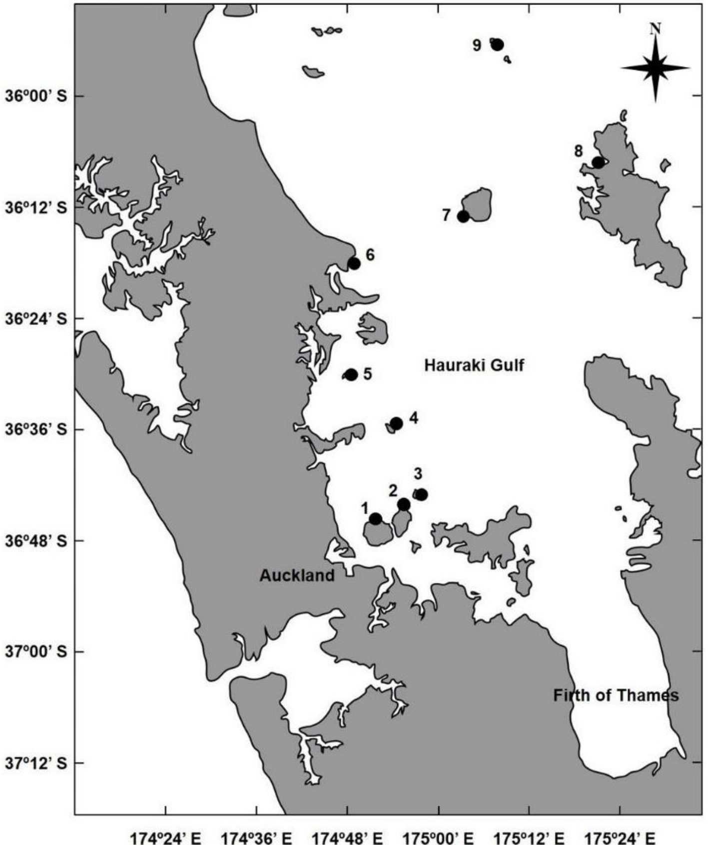
- Some adaptation to low light in kelps

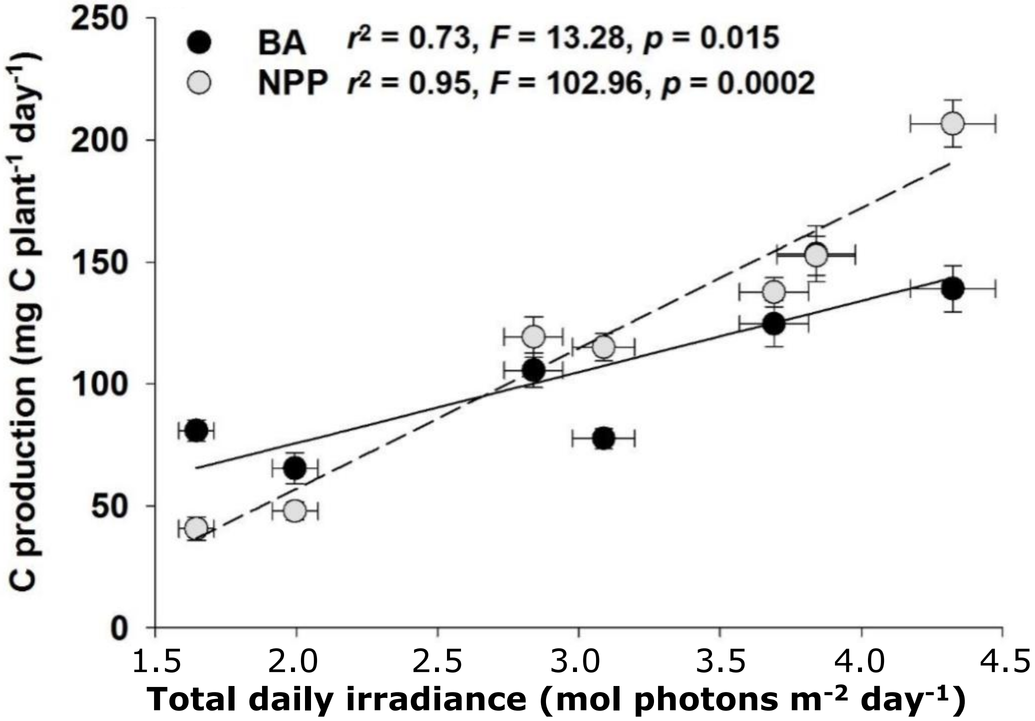




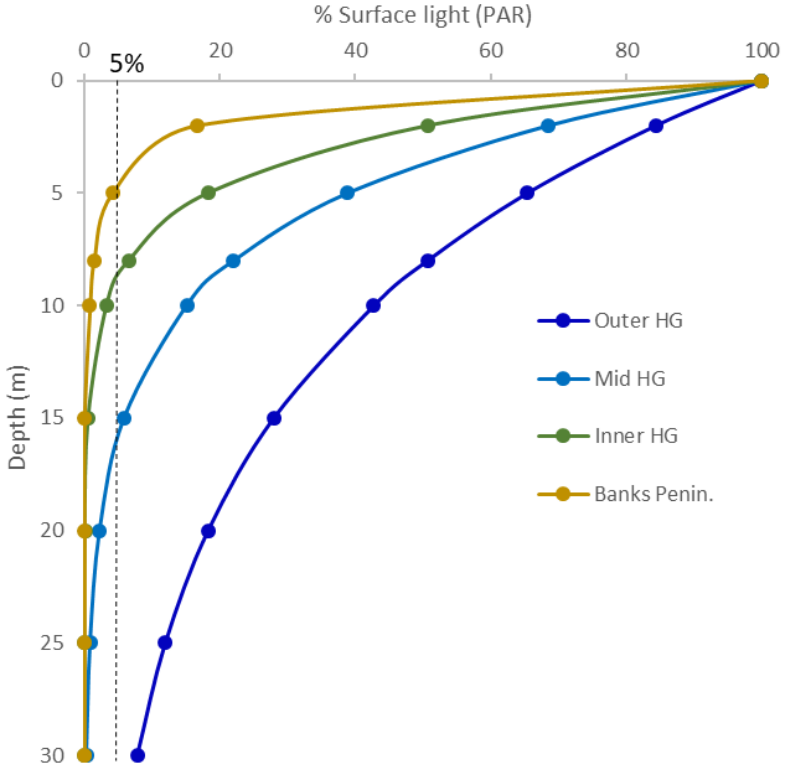
Kelp forest productivity

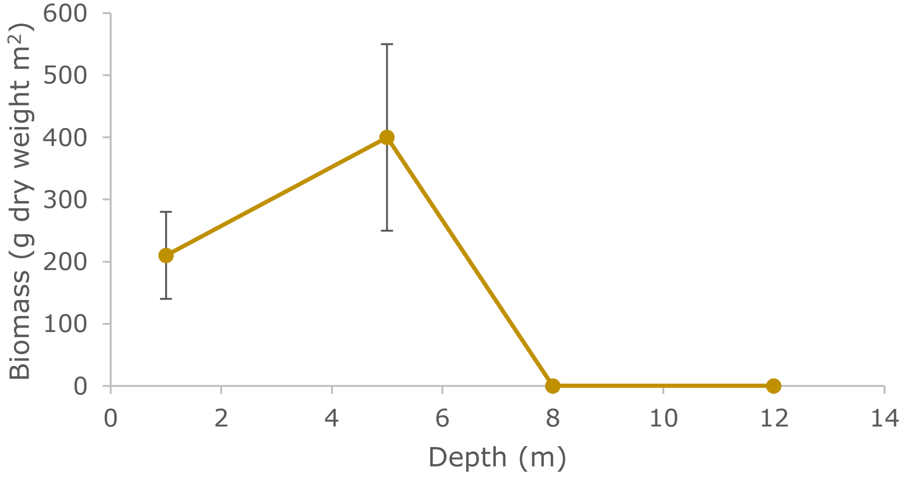
- Annual net primary productivity ~4 x higher in outer Gulf

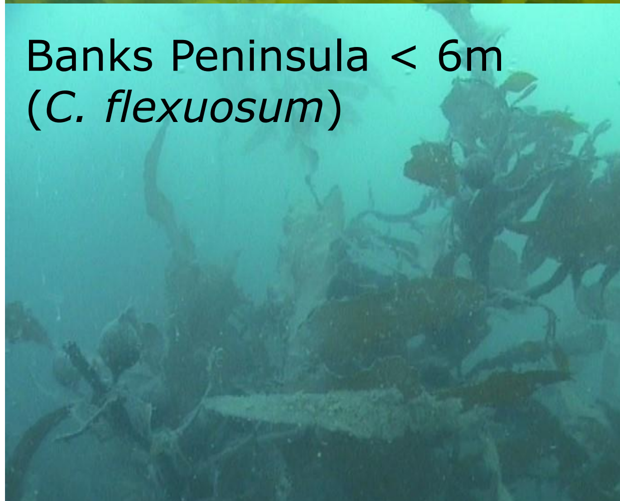




Shallowing of macroalgae with increasing turbidity





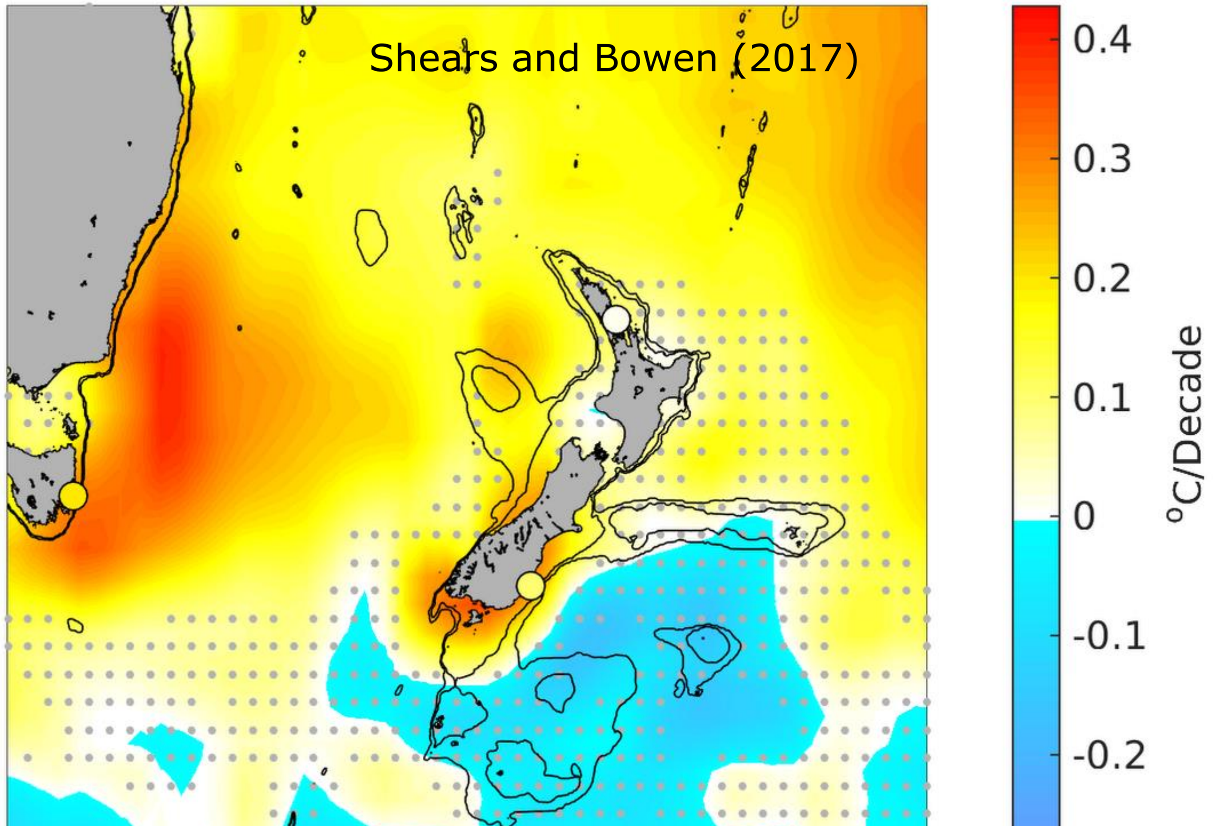


Sedimentation

- Highly spatially variable around NZ coast
- Increasing turbidity…
  - Shift from kelp to low light tolerant species
  - Shallowing of macroalgae
- Consequences for the function, values and mauri of shallow reefs
- EBM Indicators of sediment impacts
- Recovery possible? Feedbacks?
- Improvements in land management needed – long game
- Interactions between sedimentation and fishing, and with other stressors?

Climate change…

- Increased sedimentation
- Ocean warming
- Increasing air temperature



Next steps…


North Island
Cook Strait
South Island


Ship Cove
Motuara Island
TOTARANUI - QUEEN CHARLOTTE SOUND
charted rock
Kokomohua Islands
The Twins
MARINE RESERVE
LONG ISLAND
Motungarara Island
Cooper Point
Resolution Bay
Bottle Point
ARAPAWA ISLAND
East Bay
Scott Point
Clark Point
0
1 Km

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